

Quick Connect

International and internal cooperation pave way for fast equipment repair that saves important Mir experiment

STS-79 is a story about cooperation—just as all Phase 1 shuttle missions have been. But one example of that cooperation among NASA teams and between American and Russian teams stands out in particular now that the fourth shuttle-Mir docking mission is complete.

“It ain’t Apollo 13,” quipped Mission Scientist John Uri, “but from a scientist’s perspective we pulled it off and saved that experiment.”

The story started the morning of Sept. 23 with the discovery by the Middeck Payload Operations Directors that one of the first powered payloads being transferred to Mir was not working correctly. The Biotechnology System-Cartilage (BTS-CART) experiment, designed to support three-dimensional growth of cartilage in microgravity, was transferred from the shuttle middeck to the Priroda module of the Mir Space Station on Flight Day 5.

Several days later, as the shuttle was preparing to undock from Mir, the BTS-CART ground support team became concerned that the experiment was having hardware and/or software troubles when data from the flight unit and the ground-based version of the experiment didn’t agree.

“No one could understand the erratic data we were receiving,” said Uri, who was the senior representative in the Payload Operations Support Area that morning.

Any delay in their assessment of the health and status of the experiment could have resulted in a major loss of science data if it had not been fixed within a day or two, said JSC’s Biotechnology Program Chief Scientist Steve Gonda.

“Any time you have a biological system, there are time-critical constraints on keeping it the right temperature, feeding it the right nutrients, removing waste,” Gonda said, “and that depends upon the operation of the experiment control computer that monitors those parameters through in-line sensors.”

So, Lockheed-Martin’s Lead MPOD Lynn Pickett, Biotechnology Program Integration Manager Dianne Byerly and their team asked Mission Specialist Jay Apt to take Electronic Still Camera photographs of the cartilage constructs through the experiment viewport so that they could be compared with the ground-

based experiment.

Apt took several photographs of the exterior configuration of the bovine cartilage-growing experiment, but he was unable to take any close-up photographs through the viewport window because of a broken interior light.

Nevertheless, Apt downlinked the images using the Orbiter Communications Assembly. While awaiting downlink and processing of the ESC images, the BTS ground team worked intensely on troubleshooting procedures that would need to be delivered to John Blaha, now residing on Mir—the only crew member trained to perform them. The BTS team went through the procedure just as Blaha would perform it, and wrote up a flight note. Uri said the team knew it was running out of time but didn’t have a link through Mir air-to-ground channels.

Clearing that hurdle of getting the instructions to Blaha was next. Direct communication between Mission Control-Moscow and Mir wouldn’t be available for several hours, so the BTS ground team started working with Mission Control-Houston to arrange uplink of the necessary malfunction procedures through the shuttle communications link. With hatches almost ready to be closed, the ground team working on the troubleshooting procedures also started to consider the possibility of transferring the equipment back to *Atlantis* for return to the Earth.

The team generated its repair message and sent it to Blaha, who performed the procedures, but the hardware and software did not respond as hoped.

At that point on Flight Day 8, the hatches had to be closed so that *Atlantis* could undock from Mir. This meant there could be no further assistance from the shuttle crew.

But the shuttle still could be used in the trouble-shooting effort — this time as a communications relay station. Using *Atlantis’* second air-to-ground communications link (A/G-2) communications link, scientists and technicians in the POSA, the Houston control center for the Mir Science Payloads Team, were able to call Blaha with further troubleshooting procedures.

In the meantime, the ESC photographs had been processed by Phyllis Grounds and her team in the Payload Operations Control Center of Bldg. 30S. Dianne Valdez and

Cara White of JSC’s Digital Imaging Lab processed the images normally. Then, John Salmon, an ESC software developer for Lockheed-Martin, enhanced the photographs enough to show the status of the cartilage constructs inside

began its fly-around of the Russian space station. During the fly-around, John Blaha called from the Mir via the shuttle communications link to report that further attempts to fix the problems had failed.

The air-to-ground relay was enabled again to allow the POSA in Houston to discuss the suspect cable connection, since communication directly from Russia was still unavailable. They arrived at a solution, but the repair procedures still had to be approved by Mission Control-Moscow before they could be voiced up to Blaha.

While this was being explained, air-to-ground communication between Moscow and Mir, via the shuttle, was suddenly acquired, and Bill Gerstenmaier, leading the U.S. consultants group in Russia, excitedly broke in to announce that the procedures were approved by the Russian shift flight director.

It was about 6:50 p.m. by then, and Gerstenmaier and Uri both talked with Blaha directly through the communications relay. It took longer to read up the 15-minute procedure than it would take Blaha to perform it.

After completing the repair, Blaha called down to report that the cable connection had, indeed, been the problem and that BTS-CART — one of his favorite experiments — was functioning properly.



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— Frank Culbertson
Phase 1 Program Manager

the experiment hardware.

“When we got the download, I knew they were waiting for the pictures, so I put off processing the other pictures (a total of 394 were downlinked during the flight) until they got what they needed,” Salmon said.

It Salmon took just 30 to 45 minutes to process the images once they were delivered by the OCA team.

“We had the payload guys hovering behind John and saying ‘Let’s zoom in on this here,’” Grounds said.

Allen Moore, support contractor Krug Life Science’s lead engineer for the BTS facility, saw in the photos that a control and data cable on the unit was not fully locked in place by the locking mechanism.

While the BTS team drew up another procedure to power down the equipment so that the cable could be re-mated without damaging the system, the shuttle undocked from Mir and

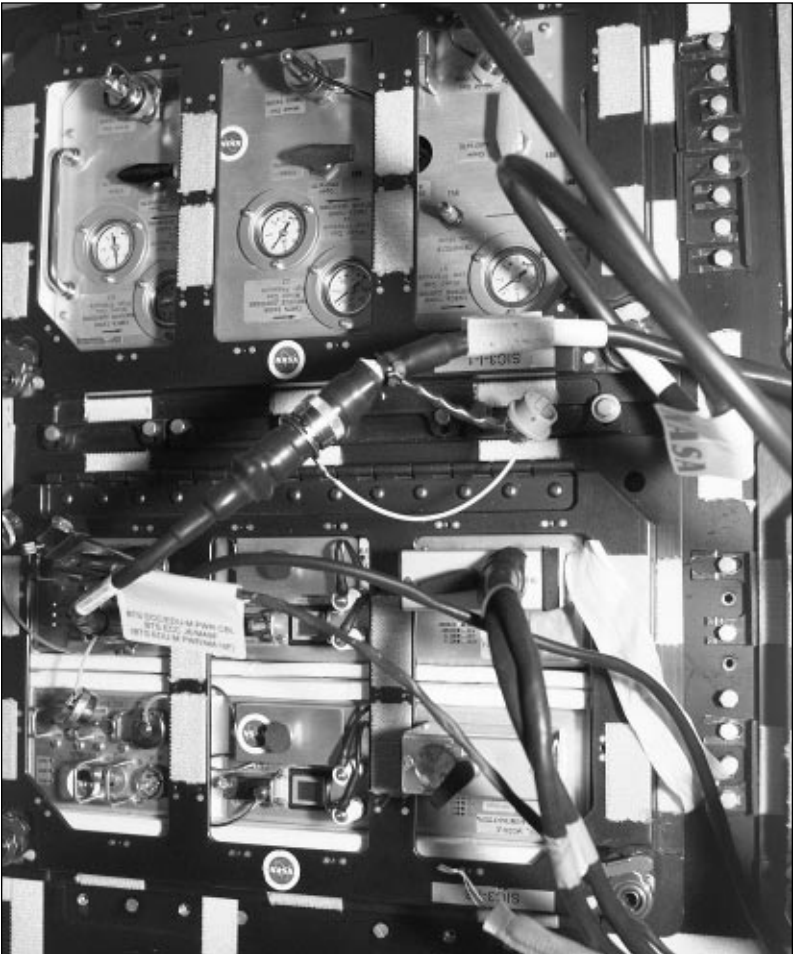
“The whole team was up in Mission Ops and when John went through the procedure we had voiced up to test the coupling and reported that all parameters came up and were nominal, there was a shout of joy that everyone voiced,” Gonda recalled. “Now we were ready to take that first long step of a 140-day long-duration cell culture, and it is a giant step for our program.”

STS-79 Lead Flight Director Paul Dye said the flight control team always tries to keep A/G-2 available as a relay option because it makes up for lack of coverage through Russian communications systems. The MCC-Houston team was happy to support the effort as long as the relay wasn’t a distraction for Commander Bill Readdy and Pilot Terry Wilcutt as they performed the fly-around.

“The entire episode illustrated the incredible levels of cooperation that have been achieved among the many ground support teams within Mission Control-Houston, as well as international cooperation between Houston, Moscow and the shuttle and Mir crews,” said Phase 1 Program Manager Frank Culbertson.

The entire process, from problem identification to solution, took only nine hours.

“This is one of the most incredible examples of cooperation across the ocean,” Uri said. “There were no brick walls. Nobody said ‘no.’ Everybody was working toward the same goal and everybody understood what that was. It saved the experiment and it was all done in real time and it really sets an example for the future. I came home from work that night and told my wife, ‘Now I know why I work at NASA.’” □



Top: The process of reading up a procedure to reconfigure the Biotechnology System-Cartilage (BTS-CART) experiment took place as *Atlantis* was circling the Mir space station. Far left, top: Departing Mir crew member Shannon Lucid works out while arriving Mir crew member John Blaha checks the daily schedule. Left: This photo showed Allen Moore, support contractor Krug Life Science’s lead engineer for the BTS, what was amiss. Far left, bottom: STS-79 Mission Specialists Carl Walz, left, and Jay Apt analyze a bovine cartilage sample in the Spacehab module before BTS was transferred to Mir.